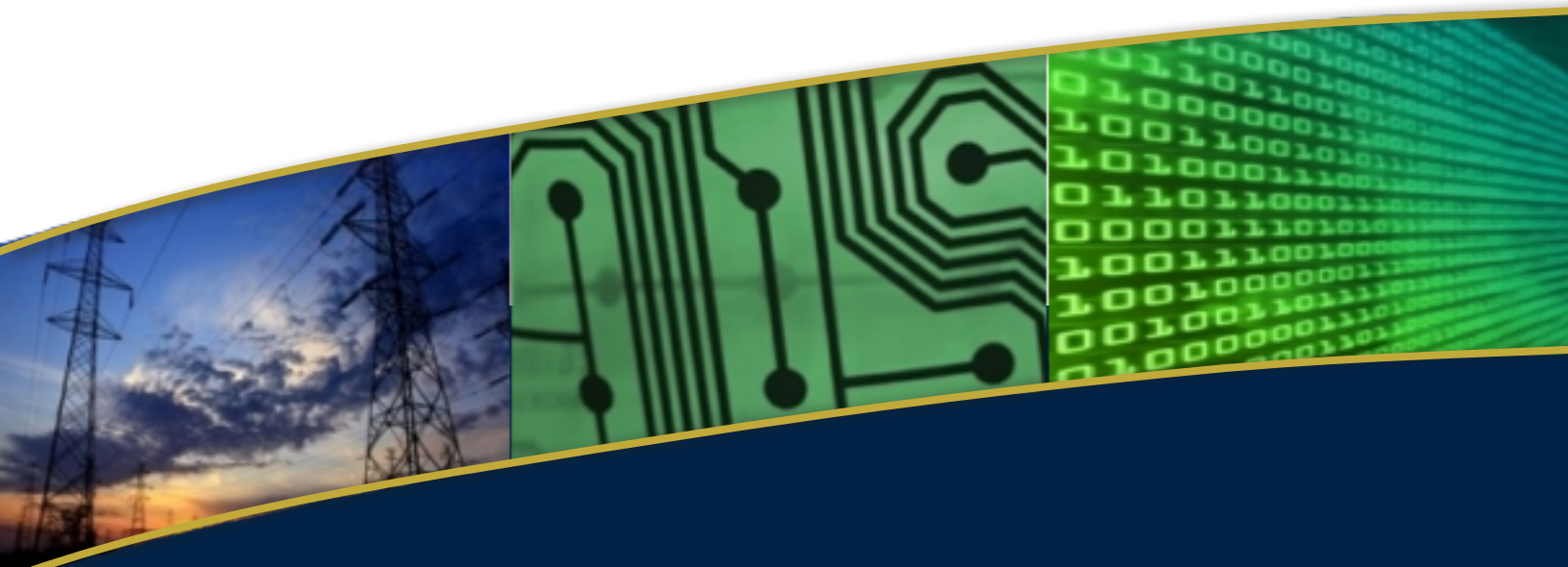
INTERNATIONAL TRADE ADMINISTRATION

2015 Top Markets Report
Smart Grid

A Market Assessment Tool for U.S. Exporters

July 2015



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Drew Bennett served as the lead author of this report. Critical insights on all the markets mentioned in the report were provided by in-country **Commercial Service energy sector specialists**. **Julian Richards** and staff from **ITA's Office of Trade Policy and Analysis** played an indispensable role in developing the methodology and gathering key data for the study. Reviewers and editors included staff from **ITA's Global Markets unit**, the **U.S. Trade and Development Agency**, the **Department of Energy's Office of International Affairs**, and the **State Department's Bureau of Energy Resources**.

Table of Contents

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Executive Summary and Findings

As global markets develop and the world's middle class grows at an unprecedented rate, opportunities to drive economic growth in the United States through expanded export sales abroad are also on the rise. With approximately 1.7 billion additional people expected to be connected to electric grids around the world by 2030, the opportunities for suppliers of electricity infrastructure and services are expected to be particularly robust. Under the Renewable Energy and Energy Efficiency Export Initiative (RE4I), the U.S. Department of Commerce's International Trade Administration (ITA) committed to develop tools that will help U.S. companies make strategic decisions and prioritize resources in their efforts to capture export gains in growing energy markets. This report delivers on this commitment for the smart grid sector: it is meant to inform U.S. smart grid suppliers and service providers of key trends, areas of opportunity, and important challenges impacting the development of international smart grid markets through 2015.

Beginning in 2009, the United States has made an unprecedented investment in the modernization of its electricity grid and has since become a world leader in the development and deployment of smart grid technology. U.S. companies large and small provide innovative technology solutions to some of the most pressing challenges facing the electricity industry, and investments by utilities and governments around the world are now driving consistent growth in smart grid exports. Supporting export growth and addressing trade barriers for the U.S. smart grid industry has been a priority for the ITA since the beginning of the President's National Export Initiative. Among ITA's major contributions to this effort has been the delivery of research and analysis and valuable market intelligence to the U.S. smart grid industry.

ITA's 2015 *Smart Grid Top Markets Report* ranks 30 international markets in terms of U.S. smart grid industry export growth potential through 2015 and provides market intelligence that will help inform U.S. companies of opportunities and challenges in international smart grid markets. The report integrates data and analysis on global markets and trade, including the critical contributions of commercial specialists from U.S. Foreign Commercial Service posts. The results are combined using a weighted scorecard methodology to produce relative rankings of the 30 subject markets.

Each subset of the smart grid sector faces different competitive challenges – and each market possesses a set of characteristics that require nuanced and tailored export promotion and policy approaches. This study is not prescriptive of actions for individual companies looking to sell products and services abroad. Instead, the methodology and rankings are meant to provide a platform for analysis that can be useful to a wide range of suppliers and service providers in the U.S. smart grid industry.

The rankings highlight common strengths and weaknesses of the various smart grid export markets. The sub-sector rankings of Smart Grid information and communication technology (ICT) and Transmission & Distribution equipment (T&D) are the result of re-weighting the Smart Grid Top Markets scorecard system to focus on differentiated opportunities for exporters of equipment and services across the smart grid technologies continuum, which is described in detail in the Report.

The following tables summarize the overall rankings and some of the common market characteristics among high, mid, and low ranking markets:

Figure 1: Projected Top Markets for Smart Grid Exports (through 2015)

1. Canada	9. Philippines	17. South Korea	25. Indonesia
2. Japan	10. Vietnam	18. Austria	26. Thailand
3. Saudi Arabia	11. Mexico	19. Brazil	27. Portugal
4. Australia	12. Turkey	20. Colombia	28. Poland
5. United Kingdom	13. France	21. India	29. South Africa
6. Singapore	14. Malaysia	22. Nigeria	30. Italy
7. China	15. Netherlands	23. Denmark	
8. Chile	16. Germany	24. Sweden	

Figure 2: Understanding Different Types of Smart Grid Markets

	Export Market Clusters	Common Characteristics	Examples *(Rank)*
Top Markets	Major Trade Partners	• Top U.S. Export Market • Geographic and/or Cultural Proximity • History of Success for U.S. Suppliers	Canada *(1)* UK *(5)* Mexico *(11)*
	Smart Grid Procurers	• Growing Smart Grid investment • Major procurements and deployments underway • Advanced Metering Infrastructure a near-term focus	Japan *(2)* China *(7)* France *(13)*
	Healthy Economies	• Stable, healthy, mid to large size economies • Favorable business environments • Investment in electricity infrastructure a priority	Australia *(4)* Singapore *(6)* Chile *(8)*
	Towards Deployment	• Surging electricity demand • Major investment growth in electricity sector • Procurements beginning and favorable competiveness for U.S. firms	Saudi Arabia *(3)* Philippines *(9)* Turkey *(12)* Malaysia *(14)*
Mid-Table	Growth Competitors	• Large markets with growing smart grid investment • Highly competitive local suppliers	Germany *(16)* Korea *(17)*
	Mature Competitors	• Smaller, high-income markets • Have already invested in smart grid infrastructure • More opportunities for smart grid ICT/Services • Less favorable to U.S. suppliers	Netherlands *(15)* Austria *(18)* Denmark *(23)* Sweden *(24)*
	Emerging Smart Grid Markets	• Low income, high growth, including in electricity demand • Major infrastructure challenges • More opportunities for T&D equipment/services • High potential for medium to long-term export growth	Vietnam *(10)* Brazil *(19)* Colombia *(20)* India *(21)* Nigeria *(22)*
Longer Term	Developing Grid Modernization	• Middle-income markets • Current focus on grid modernization • Addressing major issues in wider electricity sector • High potential for longer-term export growth	Indonesia *(25)* Thailand *(26)* South Africa (29)
	Slowing Economies	• Mid-size to large economies • Smart grid investment growth but major risks • Established incumbent suppliers • Poor economic health and/or business environment	Portugal *(27)* Poland *(28)* Italy *(30)*

In addition to the rankings and quantitative analysis, the report examines wider trends impacting the development of smart grid technologies; investment, policy, and regulatory factors driving market development; and the competitiveness of U.S. exporters across the spectrum of smart grid technologies. The report also includes in-depth case studies spotlighting smart grid developments and opportunities for U.S. exporters in 7 featured markets.

Defining the Smart Grid

The smart grid is a modernized, electricity transmission and distribution network that includes two-way communication systems and enables the integration of technologies that will further improve grid efficiency, reliability and security. Depending on the market, a wide range of equipment and technologies will be required to modernize the grid.

Modernization includes the build-out and upgrade of T&D networks that extend electricity services to new populations and also improve on the grid's efficiency in delivering those services. In many markets, modernization goes beyond these initial T&D investments, to include a range of digital technologies and platforms, including the deployment and integration of Internet Protocol (IP)-based communications infrastructure, information technology (IT) systems to better manage increasingly-complex utility networks and data, and online applications and consumer services that enable energy efficiency programs at the "user-end" of the grid.

This report considers a wide range of utility investments in T&D, communications, data networking, IT infrastructure, and energy efficiency services to be part of the worldwide smart grid opportunity for U.S. exporters. The analysis and rankings that follow consider the growth potential over the next year for U.S. exporters of the products and services detailed in Figure 3.

Additionally, U.S. exporters of related energy technologies, including microgrid systems, energy storage technologies, and a wide range of electric utility services, may find the Smart Grid Top Markets Report to be an effective guide to international market growth and potential export gains.

The available data for market sizing and measuring trade flows varies across the spectrum of technologies detailed in Figure 3. The emergent smart grid sector includes evolving networking and information technologies that are driving the convergence between communication and electricity networks. Defining the market and identifying data points that capture and distinguish smart grid investment are significant challenges to market analysis, particularly in emerging and less developed international markets.

The challenge is acute when it comes to smart grid trade data. The existing Harmonized Tariff System (HTS) includes product codes for the "Transmission & Distribution Equipment" listed in Figure 3. But for the most part, HTS product codes for the wide range of hardware, software, and networking technology are non-existent or are too broad to discern *smart grid* applications for these technologies – as opposed to *broadband Internet* applications, for example. Furthermore, data on international trade in smart grid services, like consulting, IT system integration, and consumer energy efficiency programs, is not collected by government or international institutions.

In order to quantify the global smart grid opportunity, this Top Markets Report utilizes the available U.S. Census trade data for T&D equipment, along with smart grid market and investment data – both public and proprietary – to develop a system for comparative

Figure 3: Smart Grid Technology Continuum

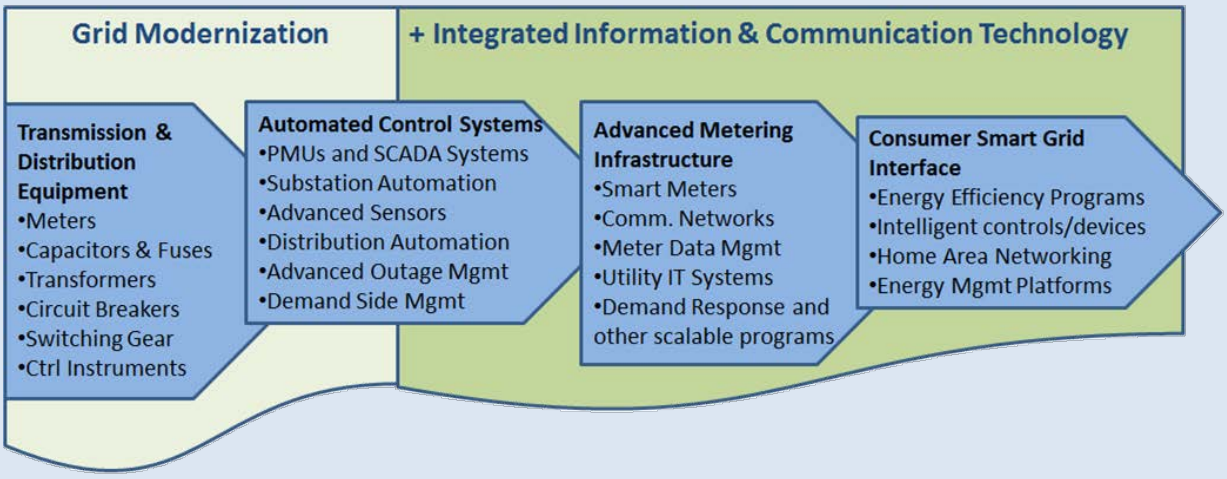
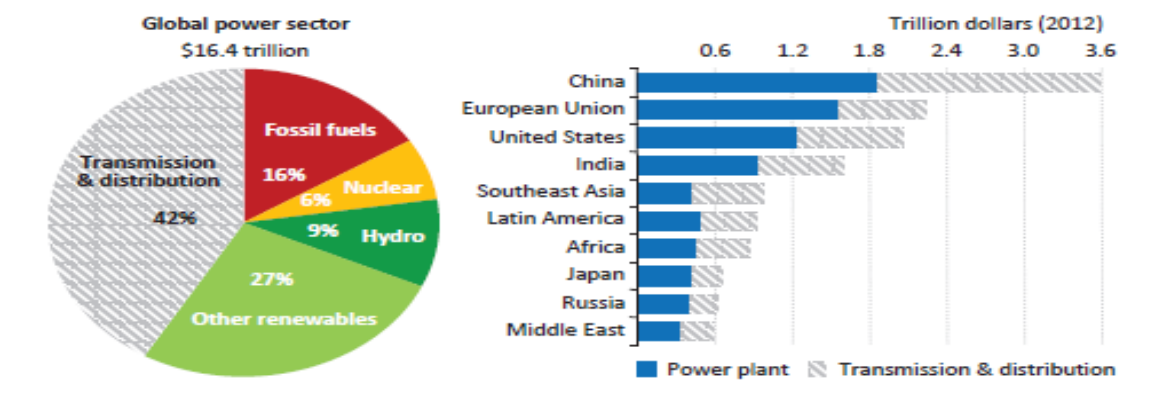


Figure 4: Cumulative Global Power Sector Investment New Policies Scenario, 2014-2035



Source: International Energy Agency, World Energy Investment Outlook 2014.

market sizing and quantifying opportunities for exporters of smart grid ICT and services. Further detail is provided in the *Top Markets Methodology* section of the study.

Smart Grid Market Drivers and U.S. Export Competitiveness

Around the world, governments, businesses, and citizens are beginning to understand that aging electric grids are not equipped to be the critical infrastructure of our energy future and are actively investing in smarter grids. Electricity demand, opportunities to realize efficiency gains, and the potential to lower carbon emissions are among the key factors driving massive global investment in the modernization of electric infrastructure and the development and deployment of smart grid technologies.

According to the International Energy Agency (IEA), world electricity demand is predicted to grow at a 2.2% Compound Annual Growth Rate (CAGR) from 2012 to 2035, and a total of 62 million kilometers of T&D lines will need to be added, refurbished, or replaced in order to meet the growing demand.[1] In the IEA's baseline scenario, the global power sector will require approximately $16.4 trillion in investment over the next 30 years, with T&D infrastructure representing the largest sub-sector share *[See Figure 4].*

Investing in the Grid to Meet National Policy Objectives
In addition to technology innovations, there are a number of policy objectives driving investment in grid modernization. Such investments have the potential to generate societal benefits satisfying three broad "policy driver" categories and supporting a range of policy objectives.

Global spending on grid modernization and smart grid technologies has emerged as a major growth segment in the infrastructure sector, achieving healthy growth even through the recession. According to Bloomberg New Energy Finance, an energy research arm of Bloomberg Media, worldwide annual smart grid spending growth peaked in 2011 at approximately 20%; suffered a loss in 2013, returned to growth at over 10% in 2014, and is predicted to exceed 12% in 2015.[2] Another energy markets research group, GTM Research, predicts that annual spending on the combined smart grid infrastructure, services, and applications markets will grow from $36 billion in 2013 to $63 billion in 2020.[3]

Smart Grid Investment in the United States
In the United States, efforts to upgrade the electric grid in order to meet America's energy, environmental, and security needs for the 21st century have accelerated both public and private sector investments in grid modernization and smart grid technologies. The Energy Independence and Security Act of 2007 (EISA) made it "the policy of the United States to support the modernization" of the electrical grid. Federal and state government and private sector stakeholders have since made major investments in the development and deployment of smart grid technologies and programs that are making the electric grid more efficient, reliable, and secure.

The American Recovery and Reinvestment Act of 2009 (ARRA) provided by far the most significant subsidy

Figure 5: U.S. T&D Equipment Exports and Global Market Share

Source: U.S. Census Trade Data via the Trade Policy Information System of the U.S. Department of Commerce: International Trade Administration

and stimulus to smart grid spending over the last 5 years, making the United States the largest smart grid market in the world from 2009 to 2012. The ARRA smart grid investments included $4.5 billion in government funding for electricity delivery and energy reliability activities to modernize the electric grid and an additional $5.5 billion in matching and additional funds from private sector stakeholders. As of December 31, 2014, approximately $7.5 billion was invested in smart grid deployments and related utility projects as a result of the ARRA programs.[4]

Development of a Smart Grid Export Base to Meet Growing Global Opportunities

As smart grid deployments have advanced in the United States, the domestic industry has developed steadily and a wide range of U.S. technology and service companies lead the global market for smart grid solutions. The available trade data on the T&D sub-sector shows U.S. export growth in total revenues and, beginning in 2009, the reversal of a decade-long trend of falling market share *[see figure 4]*.

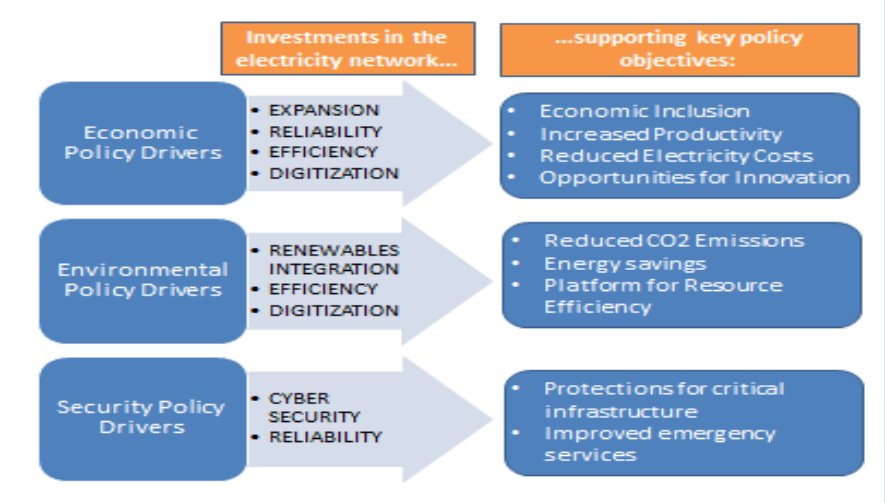
The United States is the third-largest exporter of T&D equipment, behind Germany and China.[5] While limited HTS trade data cannot accurately capture global competitiveness in the smart grid ICT sub-sector, U.S. IT, networking technology, software, and technology service firms are widely viewed as industry leaders. The growth of the domestic smart grid over the last 5 years and increased spending in international markets are now combining to provide expanded opportunities for U.S. innovators in international markets. In 2013, China surpassed the United States, becoming the world's largest market for smart grid spending.[6]

With international investment growth and high U.S. competitiveness, the smart grid sector holds great potential for continued and expanded export growth. In a September 2010 report to the President, the Export Promotion Cabinet identified smart grid as an important sector of the economy with high export growth potential and the industry has been an important component of the National Export Initiative.

Major Issues Impacting Smart Grid Development and Deployment

Investment in the smart grid continues to grow in every major economy and increased export opportunities are anticipated for the wide range of U.S. suppliers and service providers marketing smart grid solutions to electric utilities around the world. However, the development of the smart grid will be unique across – and often within – export markets, and opportunities will vary depending on a nation's stage of smart grid development and specific market demands for various technology and services. Additionally, there are a number of key issues that could impact smart grid development, challenge the

Figure 6 Investments in Electricity Networks Support Policy Objectives



pace of deployment, or hinder U.S. competitiveness in a given export market.

The Top Markets Report considers common policy, regulatory, business, and technical challenges to smart grid development and provides an analysis of their impact on specific markets. These challenges include:

- **Developing Standards and Achieving Interoperability:** the identification and adoption of international standards for smart grid technologies and the need to ensure their interoperability in order to help drive technology development, deployment, and operations.
- **Getting the Regulatory Model Right:** the need for energy sector reforms and the development of a regulatory framework that will sustain smart grid investment and enable sufficient economic returns for the electricity industry.
- **Driving Innovation in the Electricity Industry:** the need for sustainable business models and a coordinated industry approach that ensures investment in new technologies that help achieve the benefits of the smart grid.
- **Enabling the Consumer:** the need for successful consumer protections and engagement in order to help drive demand for smart grid technologies and ensure value for the consumer.

Evolving technologies and policies are driving investment in the smart grid that could translate into export returns for the United States. The rest of this report will examine country-level trends and present an analysis of the top prospective markets for U.S. T&D equipment and smart grid ICT export growth through 2015.

Top Markets Methodology

The Smart Grid Top Markets Report seeks to estimate the potential for growth of U.S. smart grid exports in global markets. This requires the integration and analysis of four broad sets of data and information:

- **Smart Grid Market Growth Potential:** industry data and information on policies, regulations, and other local drivers of the smart grid technologies and services market.
- **Trade Factors and U.S. Competitiveness:** Trade data and other information on exports of U.S. smart grid products and services in a given market.
- **Key Economic and Energy Sector Investment Indicators:** broader economic data and power sector trends that impact investment in electricity infrastructure and the development and growth of the smart grid in a given market.
- **Strength of Domestic Industry:** Trade data and other information on the extent to which demand for smart grid technology and services will be met by the domestic industry – as opposed to international trade – in a given market.

There are a variety of challenges to obtaining comprehensive and quantifiable information for each of these data sets. The smart grid is an emerging technology sub-sector that experts struggle to define, and in an era of technological convergence, many smart grid technologies are multi-use and purchased

outside of the electric utility sector. These are just a few of the factors that challenge smart grid market sizing across nations. And as was previously discussed in this report, existing global trade data only captures accurate and relevant export revenues for a sub-set of T&D goods.

In order to overcome these data challenges, the Smart Grid Top Markets Report integrates data and information on global markets and trade, and provides an analysis that quantifies smart grid markets and export growth potential with a weighted scorecard system. A detailed explanation of the methodology and key supporting data sets can be found in Appendix 1.

A Closer Look at the Top Markets Rankings

As covered in detail in Appendix 1, the Top Markets methodology integrates market data on smart grid investment and deployment data, U.S. T&D exports, policy and regulatory trends impacting market development, and a variety of factors impacting U.S. smart grid industry competitiveness in a given country. The weighted scorecard methodology provides a platform for analysis of different technology sub-sectors depending on the weights assigned to the above factors. Thus, in addition to the overall rankings, the Top Markets analysis also ranks markets for the potential growth of U.S. exports in the T&D Equipment and the Smart Grid ICT sub-sectors. Essentially, these sub-sectors are representative of technologies from the left side and the right side, respectively, of the Smart Grid Technology Continuum [*see Figure 3*].

The following table presents the top half of the Top Markets rankings, including the sub-sector rankings for T&D Equipment and Smart Grid ICT market.

T&D Equipment Sub-Sector

The T&D Equipment sub-sector rankings focus on markets with high growth in the products and services necessary for the build-out, modernization, and automation of T&D networks. For example, trade in T&D equipment receives a higher weight in this ranking, as does electricity demand growth, energy supply investment, and other factors driving the build-out of the grid.

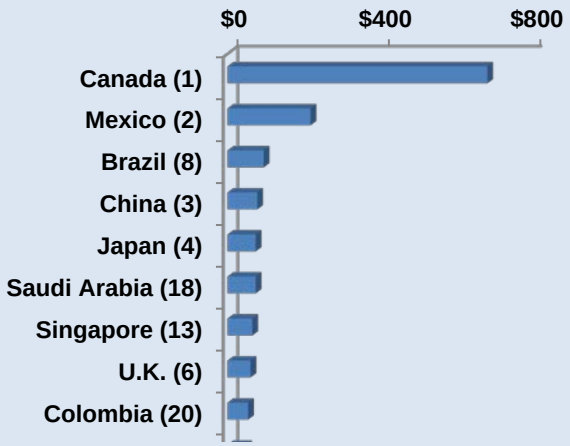
The top T&D Equipment markets are therefore likely to be less-mature smart grid markets: investments in these nations are more focused on grid modernization that is foundational to more advanced Smart Grid ICT development that is still to come. Countries that have been long-standing markets for U.S. suppliers to the electric grid rank higher in this sub-sector, this includes western hemisphere and Middle Eastern markets in particular. Additionally, many Asian markets, where connecting new populations to the electric grid is a priority, will perform well in the T&D sub-sector.

Figure 7: Top Markets Sub-Sector Rankings

	Overall	T&D Equipment	Smart Grid ICT
1	Canada	Saudi Arabia	Canada
2	Japan	Canada	United Kingdom
3	Saudi Arabia	Colombia	Japan
4	Australia	China	France
5	United Kingdom	Singapore	Australia
6	Singapore	Chile	Saudi Arabia
7	China	Vietnam	Philippines
8	Chile	Nigeria	Netherlands
9	Philippines	Malaysia	Denmark
10	Vietnam	Japan	Turkey
11	Mexico	Indonesia	Mexico
12	Turkey	Mexico	Germany
13	France	Turkey	Austria
14	Malaysia	Australia	Singapore
15	Netherlands	Philippines	Chile
16	Germany	Brazil	Sweden

Overall, U.S. T&D equipment exports have performed well in recent years and moderate growth is expected to continue. Total export revenues for the T&D equipment sector reached nearly $2.3 billion in 2013, for 1.2% year-on-year growth and a 12% CAGR over the previous decade. Exports to Canada and Mexico accounted for 39% of this total, and the top ten markets makeup nearly two-thirds.[7] As Figure 7 illustrates, top U.S. T&D export markets do not completely align with those of all goods: relative to other industries, U.S. T&D equipment manufacturers have captured significant returns in nations like Brazil, Saudi Arabia, Singapore, and Colombia.

Figure 8: Top markets for T&D Exports (Rank for U.S. Exports of All Goods) (2013 Revenues, in millions)



Smart Grid ICT Sub-Sector

Nations deploying Advanced Metering Infrastructure and developing smart grid networks that are beginning to reach consumers are the focus of the Smart Grid ICT sub-sector rankings. For example, Australia and Canada have been widely recognized as first-movers on the deployment of smart meters and advanced metering infrastructure; China is now the world's leading smart meter market; and Japan, the United Kingdom, and other markets in Northern and Western Europe and the Asia Pacific region are catching up fast. Less-mature smart grid markets like Saudi Arabia, The Philippines, Turkey, and Mexico also rank well on account of high U.S. competitiveness and positive signs in the development of smart grid ICT pilots involving U.S. partners.

Case Study Analysis

Drawing from the data and information utilized in the Top Markets analysis, the case studies that follow provide in-depth analysis of the issues impacting seven featured smart grid markets, including the drivers of and challenges to smart grid deployment and the unique opportunities for U.S. exporters.

The Case Studies are meant to provide added market intelligence on markets with unique industry and/or regulatory dynamics and are therefore not confined to the highest ranking markets.

Country Case Studies

The following pages include country case studies that summarize U.S. smart grid export opportunities in selected markets. The markets represent a range of countries to illustrate a variety of points– not the top markets overall.

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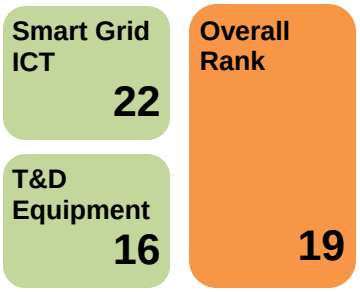
Brazil

Brazil's "mid-table" Top Markets ranking is impacted by the nation's economic and electricity demand growth, as well as a policy and regulatory environment that may constrain investment and exporter opportunities in the energy sector. Brazil is currently the largest electricity market in Latin America and one of the world's most important emerging markets, but smart grid deployments have been slowed by regulatory and technical hurdles. The business environment for U.S. smart grid exporters has been challenging as well: Brazil scores very low for export opportunities because of its historical reliance on domestic suppliers to its electricity sector, and strong local partnerships and longer timelines for investment are usually required of foreign entrants.



U.S. exports of transmission & distribution (T&D) equipment have grown substantially in recent years and investment in Brazil's power infrastructure will need to continue in order to meet fast-growing electricity demand, particularly in urban centers that are distanced from traditional hydro power sources. Over the last year or two, Brazil's leadership has intensified its efforts to meet electricity supply challenges, often at the expense of utilities. The utility finance environment has suffered as a result and smart grid ICT investments have been delayed.

Sustained opportunities for U.S. suppliers of T&D infrastructure are expected in Brazil, along with limited opportunities for technology and solution providers in the Advanced Metering Infrastructure sub-sector. U.S. industry and government stakeholders will have continued opportunity to provide technical support and exchanges that help strengthen the smart grid regulatory and business environment in Brazil.

Market Overview

Brazil's electricity market is heavily dependent on hydroelectric power plants - with approximately 80% of its electricity generated through hydropower in an average year, droughts can severely restrict the country's electricity generation. Increased volatility of supply and rising wholesale electricity costs have been the headline-making trends of recent years for Brazil's power sector. Public officials have focused on short-term funding solutions to these problems, financed mostly through public and utility industry debt, keeping consumer electricity prices relatively low.

Privatization and competition have been limited in Brazil's power supply and services markets; with the state-owned Centrais Elétricas Brasileiras (Eletrobrás) controlling about one-third of total installed capacity and a handful of state-owned companies generating most of the rest. Transmission lines in Brazil are largely state-owned as well, and the Operador Nacional do Sistema Elétrico (ONS) is a nationwide operator. Privatization and competition have gone much further in the distribution segment, where there are more than 60 providers across the country. While state governments are allowed monopolies over their electricity markets, many have been privatized. Approximately 70% of distribution companies rely to some degree on private capital.

Growth in electricity consumption is expected to continue in Brazil, increasing at an average of 3.8% annually between 2012 and 2022[8] and driving the need for further investment in infrastructure. Beginning in 2012, Brazil's government set out on an ambitious plan to increase and diversify its energy mix, with goals to invest approximately $235 billion and install 36 Gigawatts (GW) of hydropower, 12GW of biomass, and 11GW of wind over the following 10 years.

Although Brazil has supported renewable energy projects, particularly wind, transmission infrastructure has been inadequate, delaying a number of projects. Brazil now requires that projects involved in energy auctions prove that they have transmission lines secured prior to participating in the auctions. This will reduce the problems of delays associated with insufficient transmission infrastructure, while helping to drive the market for T&D equipment.

Figure 1: Overview of ITA's Analysis

Strengths

- Investment in new power sources and transmission build-out to ensure adequate supply are a national priority.
- Renewables growth beginning to pick up – will drive further T&D investment and opportunities for more advanced smart grid applications.

Key Trends

- Strong growth in electricity demand and continued development of infrastructure.
- Continued investment in transmission despite economic headwinds.
- Regulatory, technical, and business environment issues holding back growth potential in distribution and smart grid segments.

Risks

- Utility finance environment requires reforms to support necessary investments in next stages of grid modernization.

Poor energy efficiency and average electricity losses in excess of 15% are additional pressing issues impacting Brazil's market. Aging transmission lines delivering power over long distances combined with rampant electricity theft in segments of the distribution network are largely to blame.

The need to upgrade infrastructure is a common refrain in Brazil, but meeting the need has proved difficult. In 2012, Eletrobrás announced plans to invest heavily across generation, transmission, and distribution over the following two years, but it failed to reach its targets. The company subsequently cut its workforce and cited an imbalance between high generation costs and electricity tariffs that have been largely suppressed by national and state governments.

Policy and Regulatory Environment

Brazil's electricity market is regulated by the National Electricity Agency (ANEEL). ANEEL regulates public tenders for electricity sold to distribution utilities, sets tariffs for residential consumers in the regulated market, and is responsible for maintaining an economic balance that enables distributors to cover operating cost and recover an adequate return on investment. Meanwhile, a liberalized and unregulated system governs electricity trading between independent energy suppliers, and industrial consumers have the option of purchasing from the unregulated market.

In 2011, Brazil released its "Ten Year Energy Plan" and set a goal of adding 18 GW of renewables capacity by 2020. The expanded renewable supply is intended to diversify the energy supply mix and help Brazil meet its goals to reduce greenhouse gases, with a reduction of emissions in the range of 36.1% to 38.9% below 1990 levels. Renewable energy projects in Brazil – particularly locally sourced projects – receive favorable financing in Brazil and electricity produced from renewable sources with capacity less than or equal to 30 megawatts (MW) receives a 50% reduction in T&D tariffs. Brazil's first "solar only" energy auction attracted bids among the lowest in the world, bringing Brazil closer to achieving the world's cheapest solar contract prices – without subsidies.

Despite the long-standing goal of nationwide deployment, Brazil's smart meter market has experienced a number of false starts and the regulatory environment has not developed favorably to drive deployment. In 2012, ANEEL approved a long-awaited resolution establishing requirements for smart meters, but the regulator limited the classes of consumers for the roll-out. The smart grid market is still eagerly awaiting additional technical regulations from both ANEEL and Brazil's lead standards body, INMETRO, that will finally kick-off deployment.

Brazil's Energy Efficiency Program (EEP) mandates distribution utility spending in energy efficiency, requiring about $250m to be invested annually. However, restrictive program requirements have limited the effectiveness of spending and the wider energy efficiency market in Brazil has been stifled by a high cost of capital for financing deals.

Market Analysis

Brazil's expanding electricity needs and investment in large infrastructure projects throughout a recent period of economic growth have been important growth drivers for U.S. suppliers of grid modernization equipment and services. In 2013, U.S. T&D equipment

exports to Brazil more than doubled to over $94 billion in revenue and the country reached #3 as a U.S. global export market, ahead of China. While this level of growth is not likely to be sustained, Brazil is continuing to invest in transmission projects despite economic headwinds.

Beginning with the Lula administration, Brazil set ambitious goals for its national smart grid deployment, but the market has been slow to develop and the smart grid regulatory and business environment has fallen short of expectations. Once the technical hurdles are overcome, the market expects significant investment in smart distribution solutions that can solve the problem of electricity theft. While the smart meter market is likely to be limited to an estimated $500 million in the near-term, some of the larger, urban utilities with higher-income consumer footprints will require advanced smart grid solutions to a range of power management challenges.

Opportunities and Challenges for U.S. Companies

U.S. suppliers continue to find export success in Brazil's T&D sector, where projects are continuing apace though economic and political issues do pose a threat to future growth. Opportunities for transmission to connect areas of energy supply growth – particularly wind – to growing demand should be a focus. And as the integration of new power sources moves forward, many Brazilian utilities will require more advanced power management solutions. Brazil continues to be a challenging market for U.S firms to do business, and a great deal of upfront work to overcome both cultural and technical issues is required of technology firms in particular.

Opportunities

- Transmission build-out and solutions to ensure supply/demand balance.
- Distributed generation management as sector grows.
- Electricity delivery and demand side management solutions as smart grid deployments advance in 2015.

Challenges

- Utilities have been forced to shoulder the financial burden to meet recent electricity demand growth – an improved regulatory and finance environment will be required to drive future investments.

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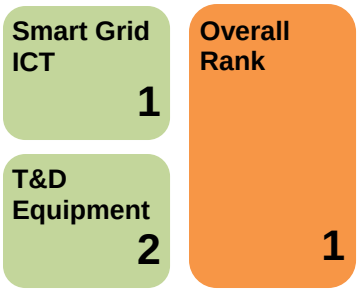
Canada

As the United States' top trading partner and a world leader in advanced smart grid deployment, Canada ranks first overall in the Top Markets Report. U.S. exporters are highly competitive and face minimal barriers to doing business in Canada, which is far and away the top export destination for U.S. T&D equipment manufacturers. There is still a high potential for growth in this market as Canada needs to invest in its aging electricity infrastructure and provinces like Alberta and Ontario are currently planning multi-billion dollar build-outs and upgrades to transmission lines.



In the Smart Grid ICT market, energy policy drivers and regulatory frameworks are in place to help sustain growth and incentivize utility investment in new applications, including Demand Response and consumer energy efficiency programs.

It is important to note that provincial policies and regulations play a dominant role in Canada's energy sector and smart grid opportunities will vary across provinces accordingly. Still, Ontario has been a global leader in areas like smart meter deployment and major investments are anticipated in British Columbia's energy efficiency market, Quebec's Advanced Metering Infrastructure, and Ontario's market for non-generation regulation resources and services.

Market Overview

Canada's large territory is endowed with a rich and varied set of natural resources, enabling the country to rank among the five largest energy producers globally. Canada is the largest foreign supplier of energy to the United States, including nearly 58 million Megawatt hours of electricity in 2012 alone. Canada currently has an estimated 137 GW of installed electricity generation capacity, dominated by hydropower (approximately 75 GW), but with a growing share for wind energy due in part to highly supportive federal and provincial policies.

Canada's ongoing efforts to transition its power supply and upgrade its electricity infrastructure should be a major driver of T&D and smart grid investment for years to come. Eighty percent of power-generation facilities in Canada are scheduled to be replaced or upgraded in the next 10-15 years and Natural Resources Canada's 2011 Clean Technology Report estimated that the smart grid industry in Canada will grow between $520 million and $2.1 billion by 2020.

Today, the majority of Canadian households have "smart" or "advanced" meters installed. Although annual deployments of smart meters nationwide slowed in 2013, *Bloomberg New Energy Finance* predicts $500 million in smart grid spending in Canada in 2014 with deployments expected to remain at approximately 1 million units per year for the next four years. Additional sales will be driven by the need for replacement of smart meters in mature markets like Ontario.

While all provinces have deployed smart meters to varying degrees, Ontario is by far the largest market and the nation's leader in terms of smart grid applications, including the utilization of time-of-use (TOU) pricing. Importantly, other cities and provinces appear to be following Ontario's lead. Montreal has embarked on a new round of smart meter deployment and is moving towards TOU pricing. And while Alberta and British Columbia are not planning to switch to TOU in the near-term, both provinces continue to invest in energy efficiency programs.

Policy and Regulatory Environment

Canada's ten provinces and three territories each govern their own natural resources. The electricity sector is under the governing authority of the respective province, and each province has developed a grid and market that is largely independent, though

Figure 1: Overview of ITA's Analysis

Strengths

- Top Trade Partner.
- Policy drivers and facilitative regulations in place.
- Market access and high U.S. competitiveness.

Key Trends

- Continued leadership in transition to renewables.
- Mature smart meter market with moderate growth.
- Opportunities for Time Of Use systems, Demand Response, Energy Efficiency, & other advanced applications.

Risks

- Provincial-level regulations are key.
- Privacy and cyber security issues currently being addressed.

border provinces are well-integrated with the U.S. grid to facilitate north-south trade. The North American Electric Reliability Corporation (NERC) oversees electricity trade and reliability in Canada much as it does in the United States, including in the development of standards for most provinces.

Due to its large hydropower endowment, electricity prices in Canada have traditionally been among the lowest in the world. However, anticipated investment in aging electric power infrastructure and the shift towards non-hydro renewable and low-carbon sources will likely increase prices over the next decade.

At the national level, Canada's energy policy is increasingly driven by climate change targets. In 2010, the Canadian Government announced its target of 90 percent emission-free electricity by 2020. Federal regulations require that plants reduce GHG emissions to no more than 420 metric tons on average of CO2 per gigawatt hour of electricity produced, though some provincial policies are actually accelerating the transition from coal in their jurisdictions. In Ontario, the last 4 coal based power plants were shut down or converted to gas, eliminating completely coal burning electricity generation.

Canada and the provinces have taken important steps to help finance investment in the clean energy sector, and private and public stakeholders alike are cooperating on research and development and other projects that are open to international suppliers and partners.

Top Markets Analysis

Canada is one of the most advanced countries in the world in terms of its smart grid development. According to a 2012 report, Canadian awareness levels of smart meters are higher than those of the United States and the potential for consumer energy efficiency programs to drive additional savings for both households and utilities were shown to be positive. Because parts of Canada are at an advanced stage of smart grid deployment, opportunities for highly competitive U.S ICT firms will be ripe. With a shared transmission network and a history of cooperation on standards, issues of interoperability for U.S. smart grid exporters to Canada will be minimized.

Electricity sector regulations throughout Canada continue to facilitate smart grid deployments and support energy efficiency as a tool to meeting climate and energy policy goals for the country. Ontario has been a world-leader in smart grid deployment and is helping to drive developments in the rest of Canada as well. Over 2.6 million customers in Ontario can now access their smart metering data through a "Green Button" format that enables energy monitoring and opens the market to a variety of consumer energy efficiency applications.

Ontario is also at the forefront in addressing issues arising at the leading edge of smart grid technology deployment. Led by its Information & Privacy Commissioner, the province is working to address consumer privacy concerns and reach out to the smart grid business community with the *Privacy by Design* international standard. These efforts, combined with commitments by both the public and utilities to improve energy efficiency, will help drive opportunities in Canada's smart grid ICT market that are matched by few other international markets.

Opportunities and Challenges for U.S. Companies:

In 2013, Canada was the #1 market for U.S. T&D exports, with $684 million in export revenue. Canada's aging electricity infrastructure and the need to upgrade and extend it to meet both household as well as commercial and industrial demands will be major drivers of investment and opportunity for U.S. T&D equipment manufacturers. Recent investments include a $3billion project to construct two 500-KV transmission lines in Alberta, and the $1 billion Lake Erie Clean Power Connector connecting the province to Pennsylvania through underwater transmission lines.

In the Smart Grid ICT realm, the relatively wide spread deployment of AMI in parts of Canada is now driving additional investment in utility IT systems and analytic software platforms and applications. Opportunities also exist for energy efficiency programs and systems marketed directly to consumers. There are a number of smart grid segments that continue to develop in Canada, with higher growth expected in certain provinces that are developing of emerging markets for the following technologies and applications:

- Advanced Metering Infrastructure (Alberta; Quebec)
- Household TOU Rates (Quebec)
- Demand Response (BC; Alberta)
- Outage Management (Ontario; Quebec; BC)
- Reactive Power Control Systems (Alberta; Manitoba; BC; Quebec; Ontario)
- Microgrids (Ontario; Quebec)
- Energy Storage (Ontario; Quebec)

Canada is also advancing the development of its electric vehicle market. Quebec and Ontario now offer electric vehicle rebates and have implemented other incentives. British Columbia Hydro is currently developing guidelines for the underlying smart grid infrastructure needed to support additional EV adoption.

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China

As the world's largest market for electricity infrastructure development and smart grid technologies, China offers great opportunities for U.S. exporters, particularly suppliers and service providers in the areas of High Voltage Transmission, synchrophasor technology and modernization of transmission operations, and partnerships in Smart City and select smart grid projects.

Smart Grid ICT	T&D Equipment	Overall Rank
17	4	7

U.S. T&D equipment export revenues to China exceeded $77 million in 2013, growing at 5.81% on the year and at a 8.75% CAGR for the decade. China ranks 4th among *top markets* in terms of recent electricity growth, and ITA expects continued investment in electricity infrastructure and opportunities for U.S. suppliers of T&D equipment.

With smart meter procurements underway and the government showing a commitment to diversifying its energy mix, reducing carbon emissions, and increasing energy efficiency, China will continue to be the largest market for smart grid technologies through at least 2015. While the bulk of smart grid technologies for China's distribution network will be provided by local suppliers in the near term, opportunities will grow for firms providing solutions to challenges of operational and network efficiency, renewable integration and management, Demand Side Management, and end-user energy efficiency.

Market Overview

China's electricity market is dominated by coal, comprising 72% of power generation in 2012, but a major objective of the current government is to decrease coal's share to 58% by 2030. Over the same period, investments in renewables and nuclear are expected to contribute the most to an expanding electricity supply that will be necessary to meet anticipated demand growth rates of approximately 5%/year over the period.[9]

China's government has made significant recent statements regarding its intent to reduce carbon emissions, including bans on new coal-fired power plants in certain regions and reports that a national cap on emissions will be introduced in 2016. Such measures will apply major pressure to the power sector and likely accelerate the market for non-coal-fired generation, as well as smart grid and energy efficiency technologies and services. Currently, overall growth of China's power sector is estimated at 7.7%, but the markets for renewable energy development, energy efficiency investment, and smart grid technologies grew at approximately 16%, 25%, and 34% in 2013, respectively.

Investment in the modernization of China's electricity infrastructure and the development of a "unified strong and smart grid" have been a focus for the country's power sector since 2010. China's largest electricity T&D company, State Grid Corporation of China (SGCC), has largely kept pace with goals outlined in the country's 12th Five-Year Plan (2011-2015) to boost grid investment by 68% over the period, particularly in ultra-high voltage transmission lines. The challenge of connecting major hydro and wind resources to distant population centers continues to be a major driver of China's growing T&D market.

China also has commitments to massively expand its use of smart meters. Through 2014, tenders for 48.7 million smart meters have been contracted.[10] Annual investment in smart metering was estimated to be $2 billion in 2013 and was predicted to reach $2.7 billion in both 2014 and 2015.[11] In 2020, China is expected to account for over 24% of the global smart grid market, at around $96 billion, according to GTM.

Policy and Regulatory Environment

The electricity market in China is heavily regulated, with power prices at the generation and consumption

Figure 1: Overview of ITA's Analysis

Strengths

- China's government is making a push to reduce the carbon intensity of its economy, largely through improving energy efficiency
- China is planning to install smart meters in every household by 2017 and then institute country-wide time of use pricing for electricity

Key Trends

- Electricity consumption in China is continuing to rise as China's economy continues expanding rapidly, though the nature of economic growth is expected to change, with more growth in the less energy-intensive service industry
- China's electricity mix will begin shifting away from coal and toward cleaner energy sources, necessitating the build-out and modernization of grid infrastructure

Risks

- U.S. entrants will face a massive challenge in the Chinese market, as local firms supply electricity networks and already have substantial market shares in the smart grid sector

levels both being set by the government. Although China has begun liberalizing the generation sector, it is dominated by five state-owned utilities that control almost half of total power generation capacity. The power transmission and distribution grid is entirely controlled by three state-owned electricity companies.

The National Development and Reform Commission (NDRC) plays a critical role in China's electricity market as the primary price-setter and regulator, and the Commission also develops and implements major policies impacting the wider energy sector. The NDRC currently dictates the pace of privatization and liberalization of China's energy markets, including the involvement of foreign competitors.

As part of a stated effort to open up the electricity sector, China is now encouraging limited foreign investment in the construction and operation of the power grid. Other market reform objectives for China's energy sector include the unbundling and separation of owners, operators, and various business units across the electricity supply chain and the creation of an open wholesale electricity market. Progress has been slow and the separation of some of the power grid operators and generation companies is all that has been achieved to date.

Electricity prices are currently separated into residential, agricultural, and commercial & industrial (C&I) tiers, with additional levels of granularity – including peak and trough pricing – offered to C&I customers. The NDRC determines the profit margins of generators and can determine prices and incentives according to supply-type. For example, beginning in 2014, the Commission will seek to incentivize investment in hydropower development through changes to the formula used to determine hydropower-based prices.

In order to balance electricity supply and demand, China is increasingly focusing on energy efficiency opportunities, including the implementation of Demand Side Management (DSM) programs. Beginning in 2011, NDRC mandated peak load reductions for grid companies of .3% annually and has since endorsed Suzhou, Beijing, Foshan, and Tangshan as DSM pilot cities where Energy Service Companies (ESCOs) and technology solution providers work with end-users and utilities to achieve energy savings through Direct Load Control technologies, interruptible tariff programs, smart metering solutions, and Time-of-Use (ToU) pricing options. ToU pricing is expected to be available beyond the pilots, with Henan and Hubei provinces intending to implement in 2015, and national implementation targeted for 2017.

As the electricity provider for over 1 billion customers and 88% of the Chinese Market, SGCC's investment portfolio and operating policies all have a major impact on the power market. Beginning in 2010, the grid operator earmarked over $40 billion for smart grid technologies and has since deployed approximately 250 million smart meters. Although SGCC has delayed its deployment goals, installation of another 50 million smart meters is expected over the next two to three years. Additionally, SGCC has updated its grid connection policies to enable the expanded installation of distributed energy resources. In order to better integrate and manage these resources, SGCC is also expected to invest over $6 billion in Distributed Automation technologies over the course of 2014 and 2015.

Top Markets Analysis

Spending on electricity infrastructure and the smart grid in China is expected to far outpace that of any other international market for at least the next five years. However, success for foreign suppliers over the period will be limited because of the focus on developing basic infrastructure and larger business issues that constrain exporters' commercial opportunities in China's energy sector.

China's *Top Markets* ranking is bolstered by high scores in electricity consumption growth, T&D and overall power sector investment, and government policies and commitment to grid modernization. However, a reliance on local suppliers and a poor competitive environment for U.S. firms have a negative impact on China's ranking, particularly in the Smart Grid ICT sector.

Opportunities and Challenges for U.S. Companies

Despite the huge investments being made in grid modernization and smart metering, the market for U.S. firms in China is significantly limited by the challenge of incumbent local supply chains and technical interoperability issues, particularly in the distribution network. However, the market for Demand Side Management (DSM) technologies that help reduce peak load and overall power consumption by end-users is an area of potential growth for U.S. exporters that have already deployed and proven these technologies at home. China is currently falling short of its goal to reduce energy consumption per unit of GDP by 15% from 2010 to 2015. Nevertheless, the national government is expected to set an even more ambitious goal for the next 5-year plan and to increase pressure on regulators and local officials to implement reforms and financial incentives to drive reduced consumption levels.

Opportunities

- Continued though declining opportunities in T&D infrastructure, particularly high voltage transmission.
- Increasing demand for network management technologies & applications following modernization of China's substations.
- Energy efficiency programs and projects with industrial and municipal partners, particularly green data center segment.

Challenges

- The Chinese electricity market is opaque and incumbent suppliers are favored.
- Local partnerships are key to success and a coordinated effort supporting U.S. industry involvement in major projects, like smart cities, will be required.

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Japan

Japan ranks 2nd among Top Markets for near-term smart grid export growth, due in large part to electricity sector reforms, energy efficiency objectives, and active technology procurements by utilities. While U.S. suppliers face difficult competition in Japan, important in-roads have been made in recent years and the market is expected to evolve favorably for innovators and entrants to a strong market.

Smart Grid ICT	Overall Rank
3	2
T&D Equipment	
10	

U.S. T&D equipment exports to Japan have increased dramatically over the last 3 years, in line with the nation's efforts to rebuild and strengthen its electricity infrastructure following the Tōhoku earthquake. The high level of investment is expected to continue, though it will shift to the distribution network, including smart grid applications and energy efficiency services.

The break-up of vertically integrated utilities, creation of a nationwide grid operator, and incentives for distributed generation and demand response are among the major overhauls to Japan's electricity market. Sustained reforms will drive the pace and scope of new opportunities for U.S. suppliers, and strong relationships with Japanese partners will continue to be a requirement in this market.

Market Overview

The Japanese electricity market has been dramatically impacted by both the 2011 Tōhoku earthquake and the policy response that followed. The damage resulting from the earthquake and tsunami – including the public concerns over nuclear energy safety – forced Japan to shut down all of its nuclear reactors, which accounted for 30% of electricity supplies at the time. The Government of Japan also shifted its focus to demand side management and an increased emphasis on energy security and resiliency through smart grid and energy efficiency technologies, creating a spark for technology markets that had long been suppressed and lacking innovation.

Japan's electricity market is dominated by 10 regional utilities that have historically controlled generation, transmission, distribution, and retail. Compared to other mature markets, electricity prices in Japan have been high, consumption levels have been low, and reliability of the network had been a focus. Following the Fukushima disaster and energy crisis, household rates rose as much as 40% in some regions, and rate hikes are expected to continue despite the re-activation of nuclear power, in order to fund continued upgrades to the system and provide relief to debt-laden utilities.

The drive for efficiency and reliability over the last three years has ultimately forced all utilities to present plans for the installation of smart meters to every household – nearly 80 million in total. The most recent plans set a deadline for 2025 for these installations, and some utilities have already begun the procurement process. ZPryme, an independent energy consulting firm, projects that the smart grid market in Japan will grow from approximately $1 billion in 2011 to $7.4 billion in 2016, and many industry estimates expect near-term smart grid spending to peak in 2015 when utilities will be completing the contracting process for smart meter and other hardware supplies.

Although Japan has begun to re-activate its nuclear supplies, major reforms of the energy sector have continued, culminating in the approval in April 2014 of the fourth Basic Energy Plan, which focuses on the policy objectives of energy security, reliability, efficiency, affordability, and reduced emissions. The full implementation of this plan – including the break-up of many traditional energy sector monopolies and further liberalization of electricity markets, will lead to dramatic changes in the technologies and services incorporated in Japan's energy infrastructure.

Figure 1: Overview of ITA's Analysis

Strengths

- The Government of Japan is providing strong support for the development of the energy efficiency, smart grid, and microgrids sectors
- Increased amount of renewables in Japan's energy matrix will continue to support the development of smart grids into the future

Key Trends

- The 2011 Tōhoku earthquake and the continued transition of Japan's energy supply mix require electricity management & efficiency solutions
- Electricity sector reforms will incentivize utility investment in smart grid and open various segments of the electricity services market to entrants

Risks

- Japanese conglomerates and local suppliers already hold strong positions in Japan's smart grid sector
- Long project timelines and burdensome technical requirements
- Full implementation of electricity sector reforms has yet to be accomplished and there is the risk of diminished achievements.

Policy and Regulatory Environment

Japan's energy market is overseen by the Ministry of Economy, Trade, and Industry (METI), which is responsible for policy planning and regulation through the Agency for Natural Resources and Energy. The Japan Fair Trade Commission monitors the state of competition and has been increasingly active in the electricity market since reforms began in the 1990s – by 2011, roughly 60% of the electricity market had been deregulated.

The 2014 Basic Energy Plan represents a complete overhaul of Japan's energy policy, utility industry, and electricity markets. While more nuclear reactors will come back online over the next few years, natural gas, coal, and renewables will make up a greater share of the nation's energy supply mix in the future. The plan did not set specific targets, but stated that the share of renewables would exceed the 20% by 2030 objective of previous policies. However, the Plan will likely ease emissions restrictions as it aims to cut emissions by just 3.8% by 2020, a lower bar compared to previous policies.

Additional reforms called for by the Japanese government include the establishment of a national grid by 2015 – including the establishment of a grid operator – and the liberalization of retail power markets by 2016. The Basic Energy Plan and related regulatory changes will effectively break-up the regional utility monopolies in Japan, opening up the $150 billion retail electricity market to competition.

Market Analysis

In addition to power sector investment in new energy supply technologies, enhanced T&D infrastructure, and energy efficiency services, Japan's government is also funding the integration of clean energy technologies and helping to drive the development of the market for smart grid applications. METI's 2014 budget includes $3.8 billion for energy improvements – a 29% increase on the previous year – specifically targeting energy efficiency and demand-side response.

While subsidies targeting energy efficiency grew by 29% in 2014 (BNEF), the key program supporting the roll-out of home and building energy management systems will fade out beginning in 2015. But the focus of both the public and private sector in Japan is expected to remain – and strengthen – on smart grid applications that help integrate renewables and manage demand, including demand response and microgrids.

Nine of Japan's ten regional utilities have completed the RFP process for smart metering systems and are in the process of selecting vendors. Meter deployments will ramp-up in 2015 with 6 to 10 million installations per year through 2022 predicted by Bloomberg New Energy Finance. As Japan's utilities deploy Advanced Metering Infrastructure (AMI), investments in meter data management and additional smart grid applications and services are anticipated. By the end of 2016, electricity retail deregulation will come into effect and most Japanese consumers will have access to live pricing and the choice to select time-of use based tariffs. If this timeline for technology deployments and market reforms is met, Japan will be

the largest foreign market for residential smart grid and energy efficiency service providers.

Opportunities and Challenges for U.S. Companies

While Japanese conglomerates and traditional local suppliers have been largely successful in winning smart metering bids thus far, as Japan's electricity market reform takes shape and its smart grid develops, additional opportunities for entrants are anticipated beyond the market for hardware. The U.S. government has already responded to these developments by shifting the focus of the 3rd U.S.-Japan Renewable Energy and Energy Efficiency Policy Roundtable towards new electricity market issues, demand response and energy management services, and distributed generation and microgrid technologies.

As Japan's electricity sector moves to a more customer-oriented and competitive structure, energy efficiency service providers and smart grid innovators with experience in mature markets like North America will be highly competitive.

Opportunities

- Integration of renewables into Japan's grid will require investment in distributed energy management.
- Meeting energy efficiency goals requires increased consumer engagement and improved data management.
- Further investment in outage systems and microgrids required to meet grid reliability goals.

Challenges

- The smart-grid remains saturated with major Japanese conglomerates such as Toshiba, Hitachi and Mitsubishi.
- Projects often have a long approval process, spanning 2 years or more.
- Japan still employs a burdensome project and technology certification process.

In addition to utility-driven smart grid deployments, Japan's Ministry of Environment has a budget of approximately USD $7 million per year for the next three years to initiate programs to develop microgrids that will improve overall system reliability, enhance renewables and energy storage integration, and incorporate EVs.

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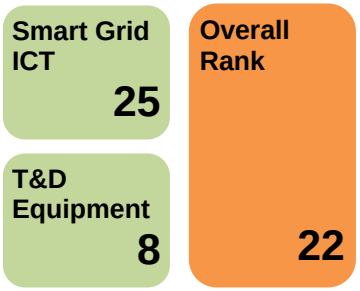
Nigeria

The recent transformation of Nigeria's power sector, combined with sustained economic growth and increasing electricity demand are driving opportunities for T&D suppliers to Africa's most populous nation and land Nigeria at #8 in the Top Markets T&D Equipment sub-rankings. Nigeria's government has thus far been responsive to the need to direct the proceeds from economic growth towards the overhaul and expansion of decrepit T&D infrastructure that currently only reaches 50% of the population.



The country's newly-privatized distribution companies are under pressure to modernize their infrastructure and quickly expand power supplies. Financing these projects will be a challenge, but efforts like the Power Africa Initiative have already helped to catalyze international investment in power and grid modernization projects. However, significant opportunities in Nigeria's Smart Grid ICT segment are not anticipated in the near-term and utility finance and business sector risks limit the potential for many U.S. exporters, keeping Nigeria's Top Markets ranking at a modest 22nd.

Market Overview

Nigeria's traditionally under-developed power sector is changing rapidly, in both structural terms – as efforts to privatize the industry take shape – and in terms of the levels of investment supporting the development of new energy supplies and improvements to infrastructure to meet surging electricity demand and support economic growth. Thermal power supplies dominate Nigeria's electricity supply mix (80%). Ssupply disruptions and shortages often result in power outages in a nation where electricity demand growth has averaged 8.5% annually over the last three years. Expanding the power supply, modernizing the electricity infrastructure, and ensuring that the energy sector is foundational to the nation's continued economic growth are top priorities for the Federal Government of Nigeria (FGN).

Nigeria has the largest economy in Africa, but well-rounded economic growth is hampered by a low electrification rate (approximately 50% of the country) and frequent power outages that cause work stoppages at industrial centers and add uncertainty to the market. The FGN estimates that an additional 26.6 GW of supply will be required to meet electricity demand by 2020.

Additionally, the Government plans to pool $2.6 billion in institutional funding for near-term investment in transmission infrastructure and the projected annual capital expenditures in the distribution sector are set for $370 million. In order to achieve its ambitious goals, the FGN will also have to ensure that investors in the newly privatized electricity sector are able to recover adequate returns and continue to fuel growth.

The structural transformation of Nigeria's power sector began in 2004 with the National Integrated Power Plan (NIPP) – a government-funded initiative to boost and stabilize electricity supplies – followed by the Electric Power Sector Reform Act (EPSRA) of 2005. EPSRA has thus far led to the unbundling of state-owned Power Holding Company of Nigeria (PHCN), a process which officially ended in late 2013 with the establishment of 15 private successor companies (five generation firms and ten distribution utilities). While transmission remains government-owned, it is estimated that up to $4 billion in funding will be required to upgrade and expand assets in the newly privatized generation and distributions sectors.

The privatization of PHCN has spurred optimism for growth in Nigeria's power sector. Investors are hoping immediate returns can be delivered from innovations and efficiencies driven by the successor companies. Growth through the transitional phase will depend on access to finance and successful upgrades to ageing infrastructure. Thus, a healthy power sector in Nigeria

Figure 1: Overview of ITA's Analysis

Strengths

- Electricity demand and grid investment growth
- Successful divestment of distribution utilities
- Smart Grid working group established as part of Electricity Distribution Services Association (ELDER) with strong commitment to national deployment

Key Trends

- Continued commitment and investment for smart grid and energy efficiency technologies by the Turkish Government
- Progress towards further energy sector divestment and electricity market reform

Risks

- Lack of national coordination in smart grid implementation
- Political and economic issues could derail electricity market reform and/or investment

will mean robust opportunities for T&D suppliers and service providers in particular.

Policy and Regulatory Environment

The FGN has made the expansion of the power supply and upgrades to T&D infrastructure policy priorities, but the country has many challenges to overcome on the regulatory and finance fronts in order to ensure necessary strong investment growth in the sector. In 2006, the Nigerian Rural Electrification Agency (RER) was set up in order to increase rural and peri-urban access to electricity from the estimated level of 35% to 75% by 2020. Beginning in 2010, privatization of the power sector became a focus, and recent progress in this effort has led to the allocation of approximately $3.5 billion for transmission investments and the mobilization of public pension funds to support investments across the power sector.

Amid the electricity sector reforms begun in 2005, The Nigerian Electricity Regulatory Commission (NERC) was established as an independent regulator. NERC monitors and regulates the electricity industry, including licensing and compliance for market participants. Over the last few years, NERC has worked to expand gas-fired supplies and issued power generation licenses to 29 independent power producers since 2011.

In 2012, NERC implemented a new Multi-Year Tariff Structure (MYTO) intended to increase electricity rates and help attract further investment to the power sector. The MYTO has gone some way to correcting policies that severely underpriced electricity in Nigeria at a high-cost to the government and to the detriment of investment in the power network. Today, the agency is focused on establishing a regulatory framework for the development of the renewables sector and for improving the efficiency of the grid, including through energy efficiency and demand-side management programs.

Grid upgrades and modernization will need to be prioritized in order to achieve Nigeria's energy supply objectives, as T&D infrastructure is currently not sufficient to reliably connect and service new renewable energy sources. The FGN estimates that 26.6 GW of additional supply will be necessary to meet total electricity demand through 2020.

A major pillar of Nigeria's efforts to improve the transmission network is the government's $23.7 million management contract with Manitoba Hydro International Limited (MHI) - a Canadian electric utility company. Under MHI's management, the Transmission Company of Nigeria (TCN) is expected to effectively and reliably wheel power from generation companies to distribution companies and eligible customers connected to the national grid. The contract also has the goal to establish local capacity in this area. System collapses and transmission losses have been a frequent issue faced by TCN and the hope is that this arrangement will reduce this issue.

Market Analysis

Thus far, investor interest in Nigeria's transformed power sector has been positive, including the U.S.-supported Power Africa Initiative. The initiative, announced by President Barack Obama in 2013, sets a goal to double access to power in Sub-Saharan Africa, with an immediate focus on Ethiopia, Ghana, Kenya, Liberia, Tanzania, and Nigeria. Power Africa's Transaction Timeline for Nigeria includes technical assistance, transaction facilitation, and credit

enhancement and financing vehicles valued at over $2billion from 2014 to 2017. As part of Power Africa, the United States and Nigeria recently signed a Memorandum of Understanding that will lead to the development of a 10,000 MW power generation project and $350 million towards transmission infrastructure projects.

A May 2014 U.S. Department of Commerce trade mission to Nigeria, led by Secretary Penny Pritzker with a focus on energy infrastructure, resulted in a number of key power sector deals. The Mission concluded with a grant signing by the U.S. Trade and Development Agency for two power generation projects and an electricity distribution modernization plan all of which have the potential to ultimately catalyze nearly half a billion dollars of investment in Nigeria's energy sector.

Opportunities and Challenges for U.S. Companies

In order to be sustainable, the proceeds from Nigeria's recent economic growth will need to be directed to grid modernization, and Nigeria's decision makers have so far proved responsive to this notion. Additionally, major consumers of electricity are also proving willing to invest in distributed energy sources to overcome grid inadequacies. While the health of the financial sector and the wider economy will be major factors, it appears that the massive demand for electricity and upgrades to power infrastructure are currently providing a healthy market for utility equipment suppliers and service providers.

Opportunities

- T&D network upgrades and expansion of backbone infrastructure.
- Metering, billing and collection software, systems, and solutions, including theft prevention.
- Global Information System (GIS) software and platforms, Supervisory Control and Data Acquisition (SCADA) systems, network monitoring & control systems.
- Outage management and emergency response solutions.
- Smart grid road mapping and strategy services.

Challenges

- Finance. The cost of lending is high in Nigeria and recently privatized distribution utilities are under pressure from local investors to provide immediate returns.
- Continued economic growth will be required to fund infrastructure projects in Nigeria's energy sector and the government will have to remain committed to increasing electricity tariff rates.
- Nigeria's government has begun to push for more protectionist legislation in recent years. Local content requirements and other protectionist policies could limit export opportunities to Nigeria.

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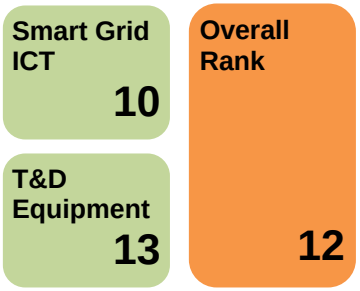
Turkey

Turkey's Top Market ranking is bolstered by strong electricity demand growth, public and private sector investment in grid modernization, and steady progress in electricity market reforms. Turkey ranks 6th among Top Markets in terms of recent electricity demand growth and it received high marks in the local Commercial Service assessment of the business environment for Smart Grid ICT firms.



Recent growth in Turkey's electricity sector has been driven in large part by state divestment of distribution utilities, which raised $13bn over 3 years. The government continues to focus on driving energy infrastructure investment despite recurring political and wider economic issues that threaten growth. After nearly a decade of steady growth, U.S. T&D equipment exports dropped precipitously in 2012, rebounded in 2013, and are expected to return to their 10% or greater CAGR trend line in 2014.

Select utilities in Turkey have begun smart grid procurements and a number of U.S. firms have already found success in the market. The continued reform of electricity markets and implementation of regulations that further incentivize smart grid investments will be needed to sustain growth and expand opportunities for U.S. suppliers to the market.

Market Overview

The Turkish power sector is a mix of both public and private entities; about half of its electricity generation is through state-owned EUAS, which operates both thermal and hydroelectric plants. The remainder of the electricity is produced by a number of Independent Power Producers (IPPs) and other privately owned companies.

Electricity distribution in Turkey is comprised of 21 regional utilities, all of which are now private entities, following the conclusion of government divestment in 2013. Transmission system operations and maintenance is controlled by the Turkish Electricity Transmission Company (TEIAS), a wholly state-owned company.

In 2012, Turkey generated approximately 228.08 TeraWatt hours (TWh) of electricity, with a generation capacity of 57,000 MW. Conventional thermal energy supplies accounted for 63% of total capacity. Non-hydro renewables currently account for just over 6% of generation, but Turkey's Energy Market Regulatory Authority (EMRA) recently launched a EUR 1.2bn tender to build an additional 600MW of solar power.

Turkey's strategy for the electricity sector is mainly driven by the objectives of increasing energy security and domestic supplies in order to meet electricity demand growth that is predicted to exceed 5% per year over the near and medium terms.

Investment is expected to continue to focus on electricity supply growth, particularly traditional thermal sources, along with some growth in the supply-share for renewables. Grid modernization and distribution efficiency will also be key objectives as Turkey seeks to capitalize on the recent divestments and reduce distribution losses that currently exceed 15% nationwide.

Policy and Regulatory Environment

Beginning in 2001 with the Electricity Market Law, Turkey has remained on a steady course to reform the electricity sector and strengthen the role of the private sector and market forces. The law established EMRA as the regulator responsible for electricity tariffs. After suppressing electricity prices for most of the previous decade, electricity rates rose dramatically in 2012 and minor increases have continued in recent years.

Figure 1: Overview of ITA's Analysis

Strengths

- Electricity demand and grid investment growth
- Successful divestment of distribution utilities
- Smart Grid working group established as part of Electricity Distribution Services Association (ELDER) with strong commitment to national deployment

Key Trends

- Continued commitment and investment for smart grid and energy efficiency technologies by the Turkish government
- Progress towards further energy sector divestment and electricity market reform

Risks

- Lack of national coordination in smart grid implementation
- Political and economic issues could derail electricity market reform and/or investment

The Ministry of Energy and Natural Resources (MENR) is responsible for Turkey's overarching energy policy. The 2009 Electricity Market and Security Supply Strategy set important policy objectives for the sector; including a goal of 30% renewables by 2023 (includes hydro). Feed-in Tariffs have been in place in Turkey since 2011 and were recently reformed in order to improve the incentives, however Turkey's tariffs remain low compared to many European nations.

The Energy Efficiency Co-ordination Board (EECB), established in 2007, is responsible for preparing national energy efficiency strategies, plans, and programs, monitoring implementation, and assessing effectiveness. The EECB has sought to align Turkey's energy efficiency policies with those of the European Union's and has set legally-binding goals to reduce energy intensity by 15% by 2020, with a focus on energy-intensive sectors such as manufacturing, transport and power generation.

Turkey is also launching energy efficiency programs that are being supported by the IFC, World Bank and the ERBD. In May 2014, the World Bank approved $350 million in financing, $50 million of which would be utilized to directly support smart-grid investments and would strengthen grid operation.

The next major milestones in the privatization and reform of Turkey's electricity market include the continued divestment of state-owned power plants (mainly gas and coal) and legislation responsive to the draft electricity law passed in March 2013. Secondary legislation to create a Turkish energy exchange to further improve the operations and transparency of electricity markets will help boost investment in utilities and support the expansion of the smart grid.

Top Markets Analysis

Despite recurring economic uncertainties over the last five years, electricity demand has continued its upward trajectory in Turkey and is forecasted to grow between 5% and 7% annually over the next decade. As a result, Turkey needs to double its power generation capacity by 2023 and the ITA expects that smart grid and energy efficiency technologies will likely be important solutions to the country's electricity infrastructure challenges.

The demand for smart grid technologies among utilities in Turkey is driven largely by the need to decrease electricity distribution losses; to increase power quality and reliability; and to solve problems encountered in forecasting and balancing markets.

Currently, Turkey's electricity loss ratio is 16%, much higher than other western European countries that average in the 4-7% range. Reducing theft and losses is a priority for Turkey and both the government and utilities view smart meters as an important tool in achieving this goal.

Smart-grid and smart-meter deployment is just developing in Turkey, with pilot projects beginning as recently as 2013. The results of these pilot projects will provide insight into the smart-grid landscape in Turkey and will likely influence the support for future investment and development of this sector.

Opportunities and Challenges for U.S. Companies:

Turkey is hoping to achieve investments of $40 billion in the electricity sector from 2010 to 2020, with the primary goals of increasing network efficiency and integrating/managing new supply sources. The Turkish government has already targeted $5 billion in

smart grid investments towards SCADA (supervisory control and data acquisition systems) and GIS (geographic information systems).

Additional prospects are services and products in the following areas:

- Automated meter reading systems
- Renewables integration and monitoring systems
- Demand management and reactive power control systems
- Utility IT and communication system upgrades

Although European suppliers have a major presence in Turkey's electricity sector, U.S. smart grid firms have proved highly competitive in the early stages of market development. The U.S. Trade and Development Agency is extremely active in supporting smart grid exporters in Turkey, including technical and regulatory workshops, feasibility studies, and pilot projects.

While the government of Turkey has set ambitious objectives in smart meter deployment, some barriers for widespread implementation of this technology remain. The smart-grid sector in Turkey often faces some of the following challenges:

- There is no responsible party ensuring the inter-operability of smart-grid elements.
- Ownership of meters belongs to customers which limits the activities of distribution companies.
- Most of Turkey's smart grid efforts have lacked national coordination.
- EMRA's commitment to facilitate utility smart grid spending is not certain as utilities await approval for next 5-year round of spending, beginning in 2016.
- Continued electricity market reforms will be an important driver for stable investment in the sector.

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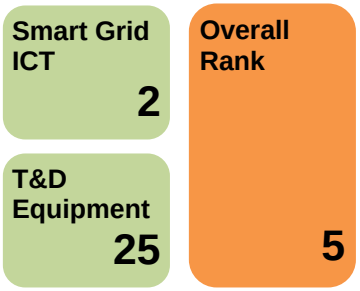
United Kingdom

The United Kingdom has quickly developed into one of the most attractive markets in the world for advanced smart grid technology and applications. Thanks to a highly competitive electricity sector and recent efforts by the government and regulators, the UK market offers immense opportunities for innovators in the smart grid ICT segment and is one of the top nations in the world for U.S. firms to do business.



The British government's commitment to a nationwide smart meter roll-out by 2020 is a key driver for its #2 Smart Grid ICT Top Markets ranking. Additionally, the regulatory framework in the UK is well developed to fund smart grid deployments, and a highly competitive market for retail electricity and consumer energy efficiency services exists. With the implementation of electricity market reforms underway, there is now the potential for the UK to develop a robust market for Demand Response and further opportunities for smart grid solutions at the distribution and consumer levels.

The potential for reduced private sector investment and competition from European vendors are the major challenges to meeting the smart grid potential in the U.K. and growing U.S. exports. To mitigate these risks, U.S.-U.K. cooperation on smart grid issues like privacy and consumer engagement should be expanded, and support for technology partnerships between British utilities and U.S. suppliers should continue.

Market Overview

Beginning in the mid-80s, the United Kingdom has been a global trend-setter when it comes to competition and innovation in electricity markets. For the better part of two decades, competition drove down electricity prices and helped to ensure robust energy supplies. However prices have been on the rise for the last ten years, and government pressure on industry to contain costs and improve consumer services recently culminated in the launch of a two-year review of the domestic energy market by the UK regulator.

The UK electricity sector is dominated by the "Big Six" energy companies – E.ON, RWE npower, Centrica, Scottish and Southern Energy, Scottish Power, and EDF Energy – that control 95% of the UK retail market. Electricity prices in the UK are solely market based and, despite recent increases, remain below EU peers like Germany and Spain. Transmission is unbundled in the UK and National Grid maintains ownership and operations of the high-voltage system in England and Wales, including interconnections with Scotland and France.

The United Kingdom is becoming increasingly concerned over energy security, as existing generation capacity is depleted, electricity imports are on the rise, and energy sector investment has slowed amid political and regulatory uncertainty. The U.K. government is faced with the challenge to facilitate investment in the electricity sector and achieve carbon reduction goals, all while containing the rising consumer electricity prices that have become a hot-button political issue.

The UK Energy Bill, including the Electricity Market Reform (EMR) bill, passed into law in December 2013 and represents the government's flagship response to electricity sector challenges. Britain's electricity market now enters a transitional phase with the potential for major commercial opportunities for energy efficiency, smart grid, and various electricity service providers.

Policy and Regulatory Environment

After more than a year of compromises and revisions from its first reading in November 2012, the coalition

Figure 1: Overview of ITA's Analysis

Strengths
- Existing regulatory framework facilitates strong funding and returns for smart grid
- Government Roadmap in place and commitment and support remain strong
- U.S. exporters have already proved highly competitive in U.K. electricity sector

Key Trends
- Smart Meter procurements have begun and major roll-out to begin in late 2015
- Electricity Market Reforms could drive Demand Response and energy efficiency opportunities

Risks
- Politics continue to threaten policy and investment in broader energy sector
- Potential under-achievement of capacity markets and renewables development
- Consumer smart grid adoption and energy efficiency programs could under-perform
- Continued delays to UK smart meter rollout resulting from technical issues and public resistance

government's U.K. Energy Bill has finally passed into law. The key objectives impacting the electricity sector include:

- Provisions to enable the Secretary of State to set a 2030 decarbonisation target – to be introduced in 2016;
- Implementation of EMR to attract GBP 110bn investment in generation and grid upgrades by 2020;
- Safety and security regulations for the nuclear sector to be implemented by the Office for Nuclear Regulation;
- Consumer protections, including limits on energy tariffs, improved transparency of electricity bills, and expansion of third-party consumer electricity services; and
- Increased coordination and strategic alignment between the electricity regulator (Ofgem) and the UK Government, including the Department of Energy & Climate Change (DECC).

Existing regulations in the UK already provide healthy support for the smart grid and energy efficiency markets, compared to other European nations, and some utilities already have their own smart meter deployments and programs underway. However, the DECC-led effort to drive deployment of 50 million smart meters has faced consistent delays and is yet to come to fruition. .

Despite delays of the DECC program, Ofgem regulations already enable utilities to include smart meter, renewable integration, and consumer energy efficiency program costs in electric bills. To further stimulate innovation in the sector, over $800 million is available through the Low Carbon Networks Fund for larger scale trials in the period from April 2010 to March 2015. After 2015, Ofgem's new performance-based RIIO framework (Revenue = Incentives + Innovation + Outputs) will involve setting eight-year price controls, offering incentives to encourage the growth of smart grids.

Taken at face value, the objectives of the Energy Bill should help drive further opportunities for these technologies and services. For example, the government has stated its intent to nearly triple the funding available for low-carbon sources of power. Additionally, new provisions for capacity markets in the UK are intended to facilitate the development of Demand Response programs. And the government's push for improved billing and energy efficiency services to consumers should open doors for various solutions providers.

In September 2013, DECC established through contract the smart metering Data and Communications Company, which will be responsible for linking all smart electricity and gas meters in homes and small businesses with the systems of energy suppliers, network operators, and energy service companies. The government has created the Central Delivery Body, which contracts with media companies, consultants, as well as electricity sector experts to support the "brand identity" of the smart metering program and ensure consumer engagement during smart grid roll-out and operations.

DECC and Ofgem created the public-private Smart Grid Forum to develop a Roadmap and Vision for the nation's smart grid. The UK smart grid program is the most well-publicized and transparent project of its kind in any market. A wealth of information is available through DECC's Website, and the annual reports on the Smart Metering Implementation Programme are highly informative.

Top Markets Analysis

The recent follow-through on government commitments to deploy smart grid technologies in the UK supports the market's #2 ranking for near-term Smart Grid ICT export opportunities. While there is some risk that private sector investment will slow amidst the implementation of energy sector reforms, current studies indicate that 60% of U.K. companies in the energy market plan to invest in smart grids before 2015, Bloomberg New Energy Finance estimates the combined market for smart grid, energy efficiency, and energy storage technologies and services in the U.K. will reach $4.5 billion by 2015.

U.S. manufacturers have already garnered success in Britain: in October 2012, US Commercial Service representatives held a Smart Grid Trade Mission in the United Kingdom that resulted in over $40 million in export success for U.S. companies. In 2013, U.S. T&D equipment exports to the UK grew over 30%, making it the 9th biggest global market for U.S. manufacturers in the sector.

Opportunities and Challenges for U.S. Companies

Despite a delay to the national smart meter roll-out and lingering uncertainties over the implementation of the EMR, the UK smart grid market continues to develop and provide opportunities for U.S. exporters. The UK DECC's assessment of future challenges to the electricity market cites the near-term need for "balancing technologies", including:

- Demand Side Response (DSR) platforms and programs;
- electricity storage systems;
- network interconnections for increased access to bulk supplies across international borders and distributed generation at the local level as well;
- distribution automation technologies; and
- consumer engagement and energy efficiency programs to support the development of DSR and achieve customer-oriented objectives of the Energy Bill.

It is also important to note that meeting electricity supply challenges in the United Kingdom will likely create opportunities for vendors in the more traditional T&D equipment segments as well. Ofgem estimates the UK will need approximately $200 billion of investment in new infrastructure such as new transformers and cabling by 2020. Additionally, DECC's Community Energy Strategy, which foresees an additional 1 million homes with distributed energy by 2020, could be a driver of future opportunities for microgrid equipment and services.

There are also a number of risk factors that could limit the great potential of the U.K. smart grid market and U.S. exporter opportunities therein. Implementation of the Energy Bill has already been highly politicized and electricity market reforms could under-achieve as a result. Additionally, many stakeholders – including consumer groups – are skeptical of the value of smart grid technologies and have raised privacy and cyber security concerns. The need to solve these issues in the United Kingdom may, in fact, create more opportunities for smart grid firms, but U.S. exporters will face top vendors from across Europe in one of the world's most promising and competitive electricity services markets.

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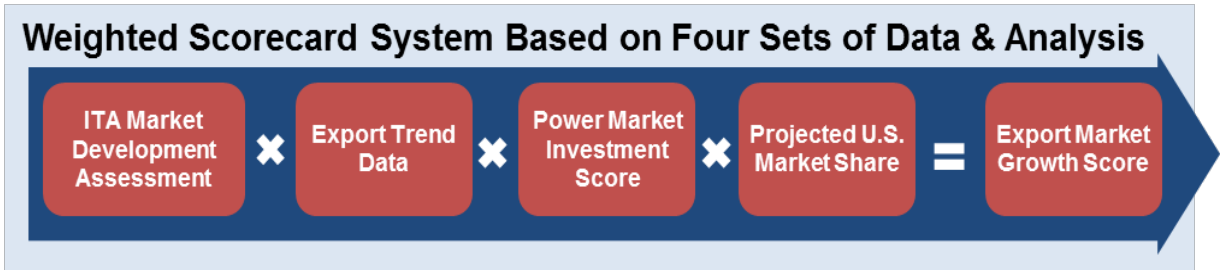
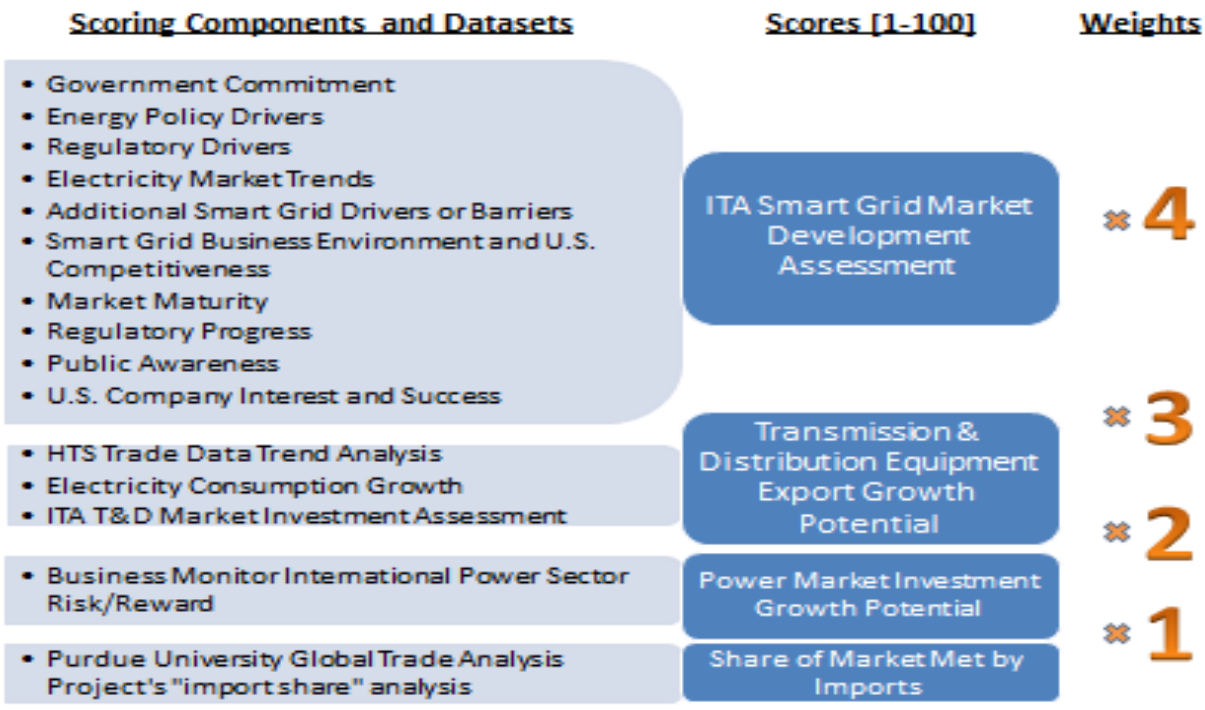
Appendix 1: Methodology

The Smart Grid Top Markets methodology integrates data and information on global markets and trade, including the critical contributions of commercial specialists from U.S. Foreign Commercial Service posts in every nation ranked in the report. The resulting data and analysis are combined using a weighted scorecard methodology to produce relative rankings of the 30 subject markets.



Each scorecard is based on quantitative and qualitative analysis that integrates data and information on key smart grid export market drivers, summarized here:

Figure 1: Methodology Overview



The following sections provide in-depth detail and reference data for each of the above components to the scorecard.

ITA Smart Grid Market Development Score

The development of the smart grid in a given market is dependent on a range of factors that can be impacted by policy, regulatory, investment, electricity industry, consumer, and/or wider economic and business environment. In order to quantify the potential for export growth in a given market, ITA developed a scoring system to quantify market potential across smart grid market drivers and factors impacting the U.S. smart grid industry competitiveness in a given market. This component of the Top Markets analysis focuses on the market potential for exporters of Integrated ICT and Services in particular (See ILLUSTRATION A in *Smart Grid Definition)* and includes the critical contributions of smart grid commercial specialists from the an International Commercial Service Post in every nation ranked in the report.

TABLE A1: SUMMARY OF ITA SMART GRID MARKET DEVELOPMENT COUNTRY SCORE CRITERIA

Driver [Share of Score]	Criteria	Example of Driver
Government Commitment [10%]	Has the government developed ambitious smart grid deployment targets and a strategic plan to achieve them? Is the government likely to follow-through on this plan and achieve these targets?	Smart Grid Road Maps, published cost benefit analysis, and government leadership to coordinate standards and interoperability are examples of government objectives and strategic planning. A country's record at meeting deployment or spending objectives is an example of evidence for follow-through.
Energy Policy Drivers [10%]	Are the country's policy and market objectives for the wider energy sector helping to drive deployment of the smart grid?	Carbon reduction, renewable integration, and increased energy efficiency are examples of wider energy sector policy objectives that would help drive the deployment of the smart grid.
Regulatory Drivers [10%]	Do regulations in the electricity sector incentivize or directly support smart grid investment or development by utilities or other stakeholders?	Regulatory frameworks that enable demand response, de-coupled markets, or energy efficiency programs would be supportive of the smart grid.
Grid Investment and Electricity Market Activity [10%]	Are utilities and other smart grid stakeholders investing in the modernization of the grid and smart grid solutions?	Market data and other factors, including the finance environment for utilities, provide a measure of grid investment in a given market.
Additional Smart Grid Drivers or Barriers [10%]	Are there other factors either supporting or hampering smart grid development in the market?	The adoption of energy storage, electric vehicles, and various green building technologies are examples of other drivers. Resistance to smart grid by consumers or other stakeholders is an example of a barrier.
Smart Grid Business Environment and U.S. Competitiveness [10%]	Does local competition or other business environment factors impact the export potential of U.S. smart grid products and services in the market?	Inter-agency experience working with the country on smart grid issues is considered in this component.
Local Assessment of Smart Grid Market and Commercial Potential for U.S. Exporters [40%]	Based on U.S. & Foreign Commercial Service specialists' assessment of market maturity (10%), government and regulator efforts (10%), public awareness (10%), and U.S company interest and export success (10%) in the subject smart grid market.	The survey also provides an on-the-ground analysis of various policies and drivers that is included in all other assessment categories above.

Transmission & Distribution Equipment Export Growth Score
The Top Markets Report seeks to quantify the discrete opportunity for U.S. manufacturers of T&D equipment. In order to estimate U.S. export growth potential to a given market, the T&D Equipment Export Growth Score incorporates existing and projected trade data, along with an analysis of additional market factors that will impact growth potential.

TABLE A2: TOP U.S. EXPORT DESTINATIONS (2013), T&D EQUIPMENT REVENUES ($MILLIONS)

PARTNER	2009	2010	2011	2012	2013	2013 Growth	2003-13 CAGR
WORLD	$1,516.39	$1,685.82	$1,960.23	$2,262.96	$2,290.31	1.21%	12.07%
Canada	$416.66	$492.45	$614.64	$748.33	$684.13	-8.58%	16.07%
Mexico	$186.37	$179.26	$206.79	$196.07	$218.01	11.19%	2.85%
Brazil	$24.34	$27.64	$34.45	$45.66	$94.83	107.71%	23.56%
China	$72.45	$59.70	$83.01	$73.58	$77.86	5.81%	8.75%
Japan	$16.48	$39.67	$68.12	$86.85	$73.88	-14.93%	8.83%
Saudi Arabia	$53.13	$44.50	$47.16	$89.10	$73.56	-17.44%	19.76%
Singapore	$16.40	$24.44	$32.90	$35.61	$65.00	82.51%	21.72%
Ecuador	$23.76	$32.63	$51.79	$45.28	$63.92	41.16%	21.28%
UK	$59.08	$33.54	$39.03	$45.59	$60.07	31.75%	8.76%
Colombia	$21.21	$32.02	$43.95	$52.05	$53.73	3.22%	27.43%
Korea	$39.20	$54.93	$45.45	$68.91	$48.45	-29.69%	9.14%
Venezuela	$30.51	$47.32	$68.72	$49.48	$47.67	-3.65%	25.14%
Russia	$38.05	$40.37	$40.61	$41.33	$44.13	6.79%	31.68%
UAE	$32.08	$24.28	$18.81	$26.12	$41.01	57.02%	20.76%
Australia	$25.63	$38.81	$33.41	$36.82	$34.03	-7.57%	6.27%
Hong Kong	$13.32	$27.41	$31.72	$27.73	$28.58	3.09%	11.76%
Norway	$18.98	$35.01	$8.75	$17.36	$26.95	55.27%	37.18%
Germany	$15.97	$20.56	$18.39	$24.32	$26.67	9.69%	-1.09%
Indonesia	$4.58	$5.25	$10.28	$20.57	$23.00	11.82%	21.11%
Malaysia	$4.47	$4.93	$6.15	$19.06	$20.75	8.83%	20.29%

The table above provides historical data on the top 20 U.S. export destinations for T&D equipment manufacturers in 2013, including total exports ("World"). ITA's analysis of the data included a vetting and smoothing of the historical data for the study's 30 markets; a trend analysis to project exports in 2015; and the development of relativized country rankings and scores based on these projections.

The trade data trend analysis is supplemented by an *Electricity Consumption Trend* score and an *Industry and Analysis (I&A) Analyst T&D Market and Investment* score. These scores seek to quantify potential growth in T&D infrastructure investment driven by a nation's recent electricity consumption trends, while taking into account various market factors – including national policy, finance, and other economic factors – that could potentially drive or hamper the build-out of T&D infrastructure. The analyst score also considers whether investment to meet rising electricity demand in a given market will be focused on more traditional T&D equipment investment, as opposed to energy efficiency or other ICT solutions that are already captured in the *Smart Grid ICT Score.*

The resulting T&D score and ranking is a relative measure of a market's potential for absolute growth in U.S. exports of T&D equipment for 2014 until the end of 2015.

Power Sector Investment Score
In order to incorporate broader economic and investment data that could impact the growth of smart grid markets, the Top Markets Report utilizes Business Monitor International's (BMI) Power Risk/Reward Rating of major international electricity markets. According to its stated methodology, BMI's score "considers a thorough and all-encompassing range of factors that affect the investment climate in the electricity sector". Because smart grid development and deployment depends on these wider factors – including the health of the electricity sector, the overall investment climate, and even the national economy – BMI's score is a valuable addition to ITA's analysis.

TABLE A3: BMI Power Risk/Reward Ratings Methodology

Weighting Of Indicators	
Component	**Weighting, %**
Rewards	**65**
Industry Rewards	**40, of which**
Electricity capacity, MW, 5-year average	10
Electricity generation, GWh, 5-year average	5
Electricity generation, %	8
Electricity consumption, GWh	5
Electricity consumption, %	8
Access to electricity, % of population	4
Country Rewards	**25, of which**
Real GDP growth, %, 5-year average	5
GDP per capita, %, 5-year average	5
Population, % change	5
Imported raw material dependence	3.5
Electricity import dependence	3.5
Inflation, 5-year average	3
Risks	**35**
Industry Risks	**20, of which**
Liberalisation level	4
Financing	6
Renewables outlook	6
Transparency of tendering process	4
Country Risks	**15, of which**
Short-term political stability	4
Policy continuity	2
External risk	3
Institutions	3
Corruption	3

Smart Grid Market Import Potential Score

A final component of the Top Markets analysis integrates data on the share of the market for electricity sector technologies that will be met by imports. This score is based on the analysis produced by Purdue University's Global Trade Analysis Project (GTAP), which estimates the share of commodities that various industries procure from foreign vs. domestic markets. GTAP's "import share" analysis includes an estimate of the electronic equipment and machinery that the electricity sector in a given market procures for its operations. While this category includes a range of equipment purchased in the electricity sector, it does provide a useful proxy – at a national level – of utility reliance on imports to meet its technology needs.

The *Import Potential Score* supplements ITA's trade data analysis and provides a proxy data point for the potential demand in a market's electric utility sector for a range of technologies, including some smart grid technologies. The *Import Potential Score* positively impacts Top Markets scores for countries that are more likely to import growing and evolving smart grid technologies.

TABLE A4: GTAP ELECTRICITY SECTOR IMPORT SHARE

Country	All Commodities	Electronic equipment, machinery	Country	All Commodities	Electronic equipment, machinery
Australia	5.8%	54.6%	Netherlands	22.9%	63.4%
Austria	39.3%	69.6%	Nigeria	31.5%	84.5%
Brazil	16.9%	18.5%	Philippines	21.0%	67.6%
Canada	21.6%	91.2%	Poland	14.8%	61.3%
Chile	55.4%	83.5%	Portugal	38.1%	64.3%
China	8.1%	23.4%	Saudi Arabia	10.0%	80.0%
Colombia	9.9%	76.2%	Singapore	52.9%	86.2%
Denmark	33.5%	65.4%	South Africa	9.6%	38.5%
France	17.8%	46.4%	Spain	41.1%	52.1%
Germany	20.2%	40.8%	Sweden	23.2%	51.8%
India	15.0%	25.2%	Switzerland	40.6%	94.0%
Italy	41.4%	26.5%	Thailand	19.8%	51.7%
Japan	30.4%	80.4%	Turkey	59.5%	41.3%
Malaysia	17.1%	82.2%	United Kingdom	24.5%	52.1%
Mexico	20.0%	90.2%	Vietnam	43.1%	87.9%

Summary Methodology and Weighted Scoring

The four scores above are combined and weighted to produce overall scores and rankings of top markets for U.S. smart grid export growth in 2015. ITA also ranks markets on a sub-sector level, differentiating between the growth potential for T&D equipment exports and smart grid ICT and services. Essentially, the former ranking covers the market for technology in the far left column of the *Smart Grid Technology Continuum*, while the latter covers everything else.

The following table summarizes the factors contributing to each score and includes the weighted contribution to the overall ranking, as well as the two sub-sector rankings.

Top Markets Score Components and Weights	Specific Factors and Metrics
ITA Smart Grid Market Development Score *****ITA scoring of country-level smart grid market drivers and business environment factors impacting U.S. competitiveness. *Considers national policies and deployment objectives; regulatory environment; trade barriers; local competition; and a range of market and investment data. *Includes market survey results completed by energy specialists from embassies in over 30 nations. *Weight: Smart Grid ICT Score (70%); Overall (40%)	Government Commitment [10%]
	Energy Policy Drivers [10%]
	Regulatory Drivers [10%]
	Grid Investment and Electricity Market Activity [10%]
	Additional Smart Grid Drivers or Barriers [10%]
	Smart Grid Business Environment and U.S. Competitiveness [10%]
	Local Assessment of Smart Grid Market and Commercial Potential for U.S. Exporters [40%]
Transmission & Distribution Equipment Export Growth Potential Score *Predicted export growth of T&D equipment, 2013-2015. Based on trend analysis of a decade's worth of census data. *ITA analyst scoring of country-level potential for investment and deployment growth in T&D infrastructure. *Weight: T&D Score (70%); Overall (30%)	T&D Trade Trend Score [50%] Electricity Consumption Growth Score [25%]

	Analyst T&D Market and Investment Score [25%]
Power Market Investment Growth Potential **Business Monitor International "Power Market Risk/Reward Ranking" - scoring of country-level power sector investment climate and potential for returns over next 5 years.* **Includes electricity market supply/demand factors; a range of national-level economic growth factors; and other drivers of power market investment.* **Weight: Smart Grid ICT Score (20%); T&D Score (20%); Overall (20%)*	Business Monitor International Score [100%]
Share of Market Met by Imports **Global Trade Analysis Project (GTAP) import share score - estimate of % of equipment imported by country's electricity sector.* **Developed and maintained by Purdue University and international researchers.* **Weight: Smart Grid ICT Score (10%); T&D Score (10%); Overall (10%)*	GTAP Electricity Sector Import Share [100%]

[1] International Energy Agency, *World Energy Investment Outlook 2014*, available at: http://www.iea.org/publications/freepublications/publication/name-86205-en.html

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[4] American Recovery and Reinvestment Act of 2009 investment data and reports available at https://www.smartgrid.gov/recovery_act

[5] United Nations Trade Data via the Trade Policy Information System of the U.S. Department of Commerce: International Trade Administration

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[9] BNEF, *China Power Market Outlook 2030*, 24 September, 2013.

[10] BNEF, *Q3 2014 Global Digital Energy Market Outlook*, 14 July, 2014, pg. 12

[11] BNEF, *The Competitive Landscape for Smart Metering in China*, 1 December 2013, pg. 1.

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